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## Claims

- 1. Polyfunctional polymer monolayer comprising an assembly of polymer chains attached to a surface obtainable by a process comprising the steps of:
  - a) covering the surface with a monolayer of a polymerization initiator which comprises one or more functional groups suitable for attachment to the surface; and
  - initiating and carrying out a polymerization reaction in the presence of monomers carrying functional groups which allow a coupling reaction of the obtained polymer chain with specific sample molecules,

wherein each polymer chain comprises a multitude of identical or different units carrying one or more functional groups which allow an interaction of the polymer with a sample or probe molecule.

- 2. Polymer monolayer according to claim 1, wherein the polymer chains are covalently attached to the surface.
- 3. Polymer monolayer according to claim 1 or 2, wherein the functional groups are chosen from carboxylic acids, maleinimides, N-hydroxy succinimides, epoxides, isothiocyanates, isocyanates or azides.
- 4. Polymer monolayer according to any of claims 1 to 3, wherein the sample molecule or probe molecule is chosen from proteins, peptides, polysaccharides or nucleic acids and derivatives thereof.
- 5. Polymer monolayer according to any of claims 1 to 4, wherein the polymer comprises segments that make the layer water swellable.

- 6. Polymer monolayer according to claim 5, wherein the water swellability is provided by monomers chosen from acrylic acid, methacrylic acid, dimethyl acrylamide or vinyl pyrrolidon.
- 7. Polymer monolayer according to any of claims 1 to 3, 5 and 6, further comprising a multitude of identical or different probe molecules immobilized at the polymer chain via a reaction with the functional groups.
- 8. Polymer monolayer according to claim 7, wherein the probe molecules are selected from nucleic acids, PNAs, polysaccharides, proteins and peptides.
- 9. Surface carrying a polyfunctional polymer monolayer according to any of claims 1 to 8.
- 10. Surface according to claim 9, wherein the polymer chains are in the form of patterned arrays.
- 11. Process for the production of a polyfunctional polymer monolayer according to any of claims 1 to 8, comprising the steps of:
  - a) covering the surface with a monolayer of a polymerization initiator which comprises one or more functional groups suitable for attachment to the surface; and
  - b) initiating and carrying out a polymerization reaction in the presence of monomers carrying functional groups which allow a coupling reaction of the obtained polymer chain with specific sample molecules.
- 12. Process according to claim 11, wherein the initiator comprises a chlorosilane, an alkoxysilane, a disulphide or a thiol group.
- 13. Process according to claims 11 or 12 wherein the initiator comprises a group chosen from azo groups, peroxo groups, or a ketone group in conjugation with an aromatic system.
- 14. Process according to claim 13, wherein the initiator comprises a group chosen from aromatic ketones or aromatic ketones containing sulphur.

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- 15. Process for the detection of sample nucleic acid molecules, using a polymer monolayer according to claim 7 or 8, which comprises the steps of
  - a) allowing a hybridization reaction to take place between the probe and the sample, followed by
  - b) removal of the non hybridized nucleic acid molecules in a washing step and
  - c) detection of the hybridized nucleic acid molecules.
- 16. A process for purifying a compound from a sample comprising the steps of
  - (a) contacting the sample with the polymer monolayer of any of claims 1 to 8, under conditions that allow binding of said compound to the functional group of the polymer chain or the probe molecule;
  - (b) and removing material from the sample that has not bound to the polymer layer or a probe molecule;
- 17. The process according to claim 16 further comprising
  - (c) eluting the bound complex from the polymer layer.
- 18. The process according to claim 16 or 17, wherein said compound is a nucleic acid, a (poly)saccharide or a (poly)peptide or a complex thereof, preferably an antibody or a fragment or derivative thereof.
- 19. Use of the surface according to claims 9 or 10 as an affinity matrix.
- 20. Use of a surface according to claims 9 or 10 in a sensor chip.
- 21. Medical or diagnostic instrument, comprising a surface according to claims 9 or 10.
- 22. Use of a surface according to claims 9 or 10 for the immobilization of starter molecules for the formation of oligo- or polymers, preferably for nucleic acid or peptide synthesis.
- 23. Use of polymer layer according to any of claims 1 to 8 as a gel in the separation of molecules in an electric field.